STRUCTURAL FEATURES OF MAGNETITE FROM MAGNETOTACTIC BACTERIA. P. Majhi[1], B. Devouard[1], M. Pósfai[1], X. Hua[1], D. A. Bazylinski[2], R. B. Frankel[3], and P. R. Buseck[1], [1]Departments of Geology and Chemistry, Arizona State University, Tempe AZ 85287-1404, USA, [2]Department of Microbiology, Iowa State University, Ames IA, USA, [3]Department of Physics, California Polytechnic State University, San Luis Obispo CA, USA.

The occurrence of single-domain magnetite in ALH84001 is one piece of evidence advanced for the possible former existence of life on Mars [1]. This magnetite has been compared to the biogenic magnetite synthesized intracellularly by magnetotactic bacteria [2,3]. However, Bradley et al. [4] observed structural defects in the ALH84001 magnetite that they report are not encountered in magnetosomes.

Twinning as well as elongated morphologies have been reported in magnetosomes [2,5]. In order to clarify if any microstructures are characteristic of biogenic magnetite, we used high-resolution transmission electron microscopy (HRTEM) to investigate magnetosomes from five cultivated strains of magnetotactic bacteria, one of which had not previously been studied. The particle sizes, morphologies, and frequency of twins appears to be mostly species-specific.

Twinning appears to be a common defect in magnetosomes from some species (e.g., *Magnetospirillum magnetotacticum* and strain MV-4). Electron diffraction and HRTEM images (Fig. 1) unambiguously showed the twin relation to be according to the common "spinel" twin law (rotation of 180° around [111]). An unusual feature is that the twin boundary is not limited to a straight (111) plane as would be expected, but can be highly irregular (Fig. 1a). These intergrown crystals in twin orientation suggest that the individuals may have nucleated independently within a single magnetosome membrane. We also found magnetosomes displaying multiple "spinel law" twins with three individuals (fig. 1b).

Magnetite from magnetotactic bacteria can contain defects. We note that twinning does not preclude the magnetosomes from being single magnetic domains since the common [111] axis of the spinel-law is also the easy axis of magnetization. More work will be needed to determine if the defects are limited to twinning and if the irregular twin boundaries are characteristic markers of magnetites from magnetotactic bacteria.

References: [1] McKay D. S. et al. (1996) *Science* **273**, 924-930. [2] Mann S., Frankel R. B. (1989) *In*: Biomineralization: Chemical and Biochemical Perspectives, VCH, 388-426. [3] Thomas-Keprta K. L. et al. (1997) LPSC XXVIII, 1435-1436. [4] Bradley J. P. et al. (1996) *GCA*, **60**, 5149-5155. [5] Meldrum et al. (1993) *Proc. R. Soc. Lond*. **B251**, 237-242.

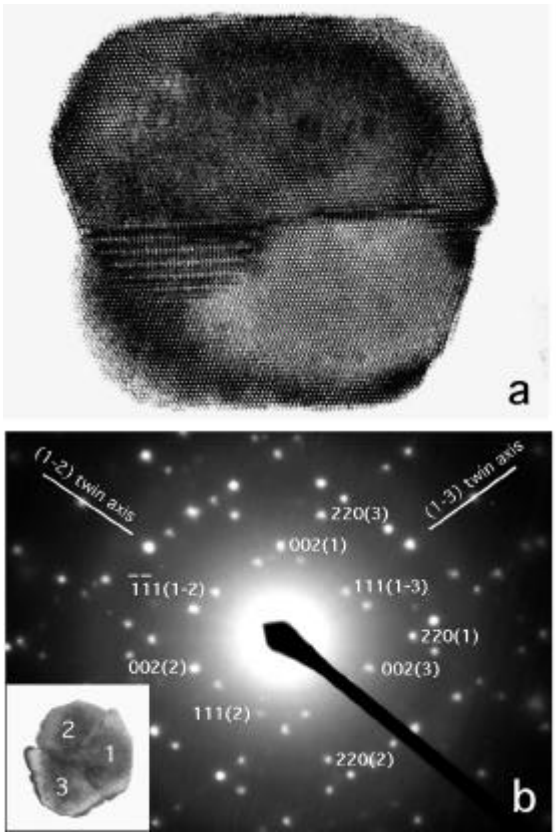

Fig. 1: Twinned magnetosomes from *M. magnetotacticum* a) High-resolution micrograph along the [110] zone axis. The irregular twin boundary induces the moiré effect. b) Low-magnification image (insert) and diffraction pattern from a multiply-twinned magnetosome.